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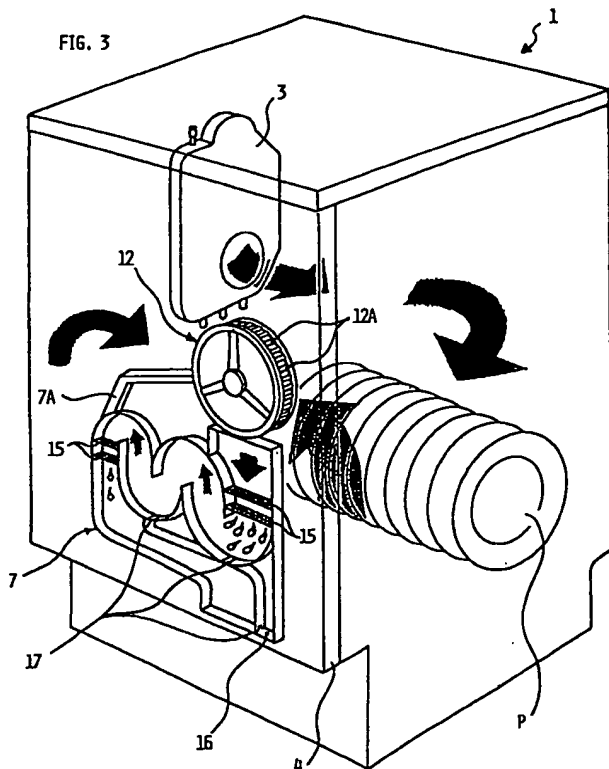
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(54) Dishwashing machine with drying fan

(57) A dishwashing machine is described, comprising a fan (12) to inhale from the washing chamber of the machine the air full of steam created by the washing of the crockery, and a hollow body (7) connected to said fan (12) for favouring the condensation of the steam contained in said air. According to the invention, means (7A)

are provided to bring again in circulation some of the air that has already flown at least one time in said hollow body (7), so as to practically obtain a closed air circulation circuit.

FIG. 3



Description

The present invention refers to a dishwashing machine with a drying fan as specified in the preamble of Claim 1.

As it is known, some dishwashing machines are equipped with a fan for causing a forced air circulation inside the washing chamber; said fan is incorporated in some types of machine which provides for a strong final drying-cycle for the dishes and pots at the end of the washing program.

The actin of said fan is intended for improving the elimination of the steam, forming inside the washing chamber, for a better drying action than that obtained with more conventional solutions, which in fact foresee that the crockery should be left inside the machine for a certain time, during which the steam is partially removed through a "condensation effect" carried out by the walls of the chamber and partially by letting the steam to exit the washing chamber.

According to the Italian Patent Application TO92A122 a dishwashing machine is known, where the drying fan is housed in a container partially recessed in the machine door. Inside the door there is also a conduit, which directly connects the rear side of said container with an aperture in the lower side of door, through which the air inhaled in the container is expelled in the external environment. In a possible embodiment of the invention, said conduit is shaped to promote the condensation process and collect the water resulting from such a condensation. To this purpose, said conduit has a drainage hole connected with the inner side of the door, through which the condensation water flows directly back to the washing chamber, and where in particular the drainage or vent hole has a valve device of the membrane-type.

However, said Italian application only provides some principle indications concerning said arrangement, without any precise indication about the execution of the condensation system, in order to avoid an always possible undesirable leakage of condensation water outside the machine and a direct exhaustion of the drying air still relatively damp in the environment where the dishwasher is installed. This is not only an unpleasant situation but it may also cause deformations to the wooden decorating panels or to the furniture placed near the dishwasher.

The realization of a drainage hole with valve on the inner side or the door of the machine is also a complication for the door manufacturing, with the risk of water infiltration in the door.

A further inconvenience caused by the above solution is due to the fan size, which in all known solution for dishwashers, is of the axial type, with a helical impeller projecting from an electric motor.

It is the object of the present invention to overcome said inconveniences and provide a dishwashing machine equipped with an improved drying circuit, which is really functional and of simple and compact design, so as to avoid the risk of water leakage and a direct flow of

damp air towards the environment where the machine is installed.

Said purposes are obtained according to the present invention by a dishwashing machine incorporating the features of the annexed claims.

Further characteristics and advantages of the present invention will results in being clear from the following description and the annexed drawings, which are supplied only by way of non limiting example, wherein:

- Fig. 1 shows schematically a section of the dishwashing machine according to the present invention;
- Fig. 2 shows schematically in section and in view the fan unit of the dishwashing machine according to the present invention;
- Fig. 3 shows schematically the drying circuit of the dishwashing machine according to the present invention;
- Fig. 4 shows schematically a detail of the drying circuit of the dishwashing machine according to a possible variant embodiment of the present invention.

Some components of the dishwashing machine according to the present invention as mentioned in the following description are not shown in the figures, since they are relatively simple and known for themselves.

Referring to Fig. 1, reference number 1 indicates a dishwashing machine according to the present invention as a whole. Number 2 indicates the washing chamber of the machine; number 3 a vent device usually provided outside the washing chamber of the dishwasher, however fitted with an aperture connecting the internal part of the chamber with the outside.

Number 4 indicates the machine loading door as a whole, which consists of an external shell 4A and an inner shell 4B of stainless steel, facing inside the chamber 2.

A screw or scroll 5 of a centrifugal fan is located among the two shells 4A and 4B of the door 4; the suction inlet of said scroll 5, shown more in detail with reference to Fig. 2, communicates with the chamber 2 through an aperture being present on the inner shell 4B. To this purpose a cover, indicated with number 6, is provided and fastened on the inner shell 4B, which is provided with some suction apertures adequately screened to hinder the water passage during the washing cycles.

The delivery outlet of the scroll 5 is, viceversa, in communication with a condensation body, indicated with number 7, which is also inserted between the two shells 4A and 4B of the door 4. The body 7 and the scroll 5 are also connected to each other through an external recirculation conduit 7A, shown by a hatched line in the figure. The body 7 and the conduit 7A will be better described in detail with reference to Fig. 3.

The condensation body 7 has on its lower side a drainage hole for the condensation water, in communication with the external part of the door, since the inner shell 4B is open on its lower side. In particular, this drain-

age aperture has been so shaped to let water dripping to fall over a front lip number 8 of the bottom of the chamber. Said lip 8 protrudes in the area extending under the inner shell 4B outside the chamber 2 and in the external environment. Number 9 indicates a rubber gasket, as usually known, fastened to the lip 8 on the chamber bottom and interacting with the lower side of the inner shell 4B. The rubber gasket 9 has suitable slots on its external side, for allowing the water collected on the lip 8 to flow back into the chamber.

The air circulation circuit will be described more in detail with reference to Fig. 3.

Fig. 2 illustrates the ventilation unit of the dishwashing machine according to the present invention. The cited scroll 5, which can be e.g. of plastic material, is fastened to the shell 4A with its suction inlet as shown schematically with number 10 and directed towards the inner shell 4B; said inner shell 4B has a relevant aperture on the chamber 2 and is screened by the cover 6 as mentioned above. The scroll 5 also has a side inlet, not shown in Fig. 2, connected with the conduit 7A shown in Fig. 3.

The delivery outlet of the scroll, indicated with number 11, is directed downwards for its coupling with the condensation body 7, also fastened to the shell 4A.

As said, the fan of the machine according to the present invention is of the centrifugal type, instead of the axial type, and the impeller is concentric to its motor. In fact, as it can be seen in Fig. 2, the fan impeller, indicated with 12, is conceived to have its electric motor, indicated with 13, arranged concentrically to it, i.e. within the space requirement of the impeller 12 itself (both the impeller 12 and relevant blades 12A can be seen more in detail in Fig. 3). The motor 13 is obviously of the hygroscopically protected type.

Such a solution, with a concentric and centrifugal fan, allows to greatly reduce the space requirement for the ventilation unit. In any case, this solution has a considerably smaller space requirement with respect to an axial fan of equivalent efficiency according to the known state of the art (type with a fan projecting from the motor). It is also clear, according to another standpoint, that in the case of equivalent space requirement of a fan according to the known state of the art and a fan according to the present invention, the latter can ensure a higher efficiency.

Figure 3 shows schematically the drying circuit of the machine according to the present invention. In said figure the same reference numbers of the previous figures are used to indicate the same elements.

The condensation body 7 which, as said, is located between the inner shell 4B and the external shell 4A of the door 4, is hollow inside, has a relatively restricted section and is advantageously realized in a single piece, e.g. of plastic material.

Said body 7 is shaped so as to present a series of curves (four in the example shown, i.e. two above and two below) defining a tortuous air pathway. Said pathway has a clearly bigger development, if compared to that

defined by the simple vertical and horizontal dimensions of the body 7.

Reference number 15 indicates some condensation grids, located along the air pathway and fixed adequately on the body 7, through which the air is forced to flow. In particular, said grids 15 consist of perforated foils or mesh in a material able to favour the condensation of the damp air inhaled from inside the chamber 2. Said material could advantageously be austenitic and/or non-magnetic steel, in order to avoid possible corrosion of the screens 15, such as stainless steel grade AISI 304.

Reference number 16 indicates a drainage hole being present on the lower side of the body 7. The body 7, as said, is housed in the door 4 so as to be above the lower open area of the inner shell (4B, Fig. 1), i.e. that part of the door facing inside the washing chamber. In particular, the body 7 is arranged with the holes 16 slightly above the front lip 8 of the bottom of the washing chamber 2 (see Figure 1).

Number 17 indicates some intermediate drainage holes, whose purpose is that of avoiding the accumulation of the condensation water within the body 7. Said intermediate holes cause all condensation water to be conveyed in the lower side of the body 7, where the hole 16 is located.

Number 7A indicates the cited external conduit connecting the body 7 to the fan scroll (not shown in fig. 3) to allow air recirculation within the body 7. As it can be seen in fig. 3, said conduit 7A is schematically shown on the left of body 7, thus connecting the latter with the fan impeller 12.

P indicates schematically the crockery to be dried (which is, in the practice, contained in a proper basket, not shown), where the various arrows highlight the air pathway.

The operation of the dishwashing machine according to the present invention and of its relevant air circulation and condensation circuit is as follows.

At the end of a washing cycle, in itself known, the fan 12-13 starts operating on command of the machine programmer (not shown for simplicity's sake) and reaches a predetermined speed. Thus, the hot air full of steam, which naturally tends to flow upwards in the chamber 2, is inhaled in the scroll 5 through the inlet 10 and the apertures on the cover 6. As a result, and still under the inhaling effect of the fan 12-13, cold dry air is inhaled from the outside in the chamber 2, through the vent device 3.

The air full of steam passes through the scroll 5 and is forced through the delivery outlet 11 along the tortuous pathway defined by the curves of the body 7. When flowing through the body 7, the air is forced through the grids 15, which cause a fast condensation of the steam contained in the air inhaled from the chamber 2.

As it appears from the above description, it can be understood how the air inhaled from the chamber 2 loses its dampness as long as it advances in the pathway defined within the body 7, till the air becomes practically dry and steamless.

A nearly complete removal of the dampness contained in the air is obtained by recirculating the air by means of the external conduit 7A. In other words, the conduit 7A allows the air to flow several times in the pathway as defined within the body 7.

The presence of the external conduit 7A also allows to mix in the entry of the scroll 5, or if preferred of the body 7, the air full of steam from the chamber 2 with the air that has already undergone at least a first condensation process (i.e. the air already flown once or more times in the body 7 and through the grids 15).

It should also be noticed that, according to the present invention, there is no substantial emission of the recirculating air in the environment outside the dishwasher, since this is hindered by the provision of proper means in correspondence with the drainage hole 16.

Said means may consist for instance of a sponge element, located over the hole 16 which, by absorbing the condensation water collected in the body 7, hinders a substantial air flow to the external environment.

It should be mentioned at this point that also that tiny part of air possibly flowing out of the drainage hole 16 is in any case expelled within the machine, in the area which extends below the lower side of the inner shell 4B; in other words the air eventually expelled through the hole 16 is not directed towards the front part of the dishwashing machine and the nearby furniture, thus obviating to the problems mentioned at the beginning of the present description. Therefore, the lower side of the door, in particular of the shell 4A, constitutes a screening element to avoid said risks.

At the light of the above, it is clear that according to the present invention the crockery P will be dried by means of a practically closed air circulation circuit.

As said, water residues caused by the steam condensation inside the body 7 are collected by said sponge element and naturally drained away, little by little, through the hole 16.

Said residues flowing out from the hole 16 fall in particular on the lip 8 and flow back inside the washing chamber 2, through the slots on the external side of the gasket 9.

In a particularly advantageous embodiment, the dishwashing machine according to the present invention is provided with means for varying the rotary speed of the fan 12-13, for a controlled or partial steam emission from the chamber 2.

In this case, the fan is initially moved at a relatively low speed (e.g. 1200 rpm), so that during the most critical initial drying step - where the steam concentration inside the chamber is higher - the steam outflow will be slow, in order to avoid a strong steam ejection and also dilute the steam inside the chamber with fresh air gradually inhaled through the vent 3. In a second step, when most of the steam has been removed or diluted, said control means can let the fan to reach the rated speed (e.g. 2400 rpm), the commutation between the two speeds being controlled by the dishwasher timer. Obviously, more than two different speed phases can be foreseen.

According to a more sophisticated embodiment, air humidity sensing means can be provided within the washing chamber, of known type (e.g. of the type used in laundry drying machines), so that the fan rotary speed is varied by the electronic control system, just as a function of the steam concentration within the washing chamber, as detected by said sensing means.

Moreover, said sensing means can keep the drying system enabled as long as the air humidity does not go below a predetermined value, indicating a safe level for a good crockery drying result.

The implementations of the invention described above are easy, especially in the case of dishwashers provided with an electronic control system, for instance by means of a microprocessor programmed according to the fuzzy logic rules.

It is however clear that the implementation of the present invention can also apply to machines equipped with an electromechanical programmer, through any known means.

It has been practically proved that the dishwashing machine according to the present invention satisfies the intended purposes; in particular practical tests have proved that the crockery drying results are highly satisfactory without any risk of emission of damp air and condensation water to the external environment.

The characteristics and the advantages of the dishwashing machine according to the present invention appear thus clear from the above description.

It is obvious that many variants and changes are possible to the dishwashing machine described by way of example, without departing from the novelty spirit of the innovative idea, and it is also clear that in the practical embodiment of the invention, the components and materials shown may differ from those described above and be replaced with technical equivalent elements.

In a possible variant embodiment, the functions of the mentioned sponge element suitable to avoid airflow outside the body 7 can be replaced or integrated through a special drainage valve, of the type indicated with V in Fig. 4, located below the hole 16.

Said drainage valve V consists in particular of a small rubber pipe with a lower lip closure, in order to allow the flow from the top downwards. In presence of a minimum water column, e.g. 20 mm, the lower lip opens and lets the water to flow out. Therefore, it is clear that, in order to allow the airflow to pass through it, a pressure equal to 20 mm water column is needed (which is quite a respectful pressure and difficult to obtain with the dishwasher drying fan).

According to another possible embodiment, an adequate small door can be provided as an alternative to the cover 6, e.g. with an electromagnetic aperture, of the type and operation as described in the above mentioned Italian patent application.

The dimensions of the cover 6 could also be selected for allowing a direct access to the ventilation unit after its removal, whenever maintenance is required.

The configuration of the body 7 and the development of its pathway may differ from the ones shown by way of example. For instance, the curves of the body 7 are shown in a vertical direction in the figure, but they could alternatively be directed horizontally (i.e. such an S), so as to favour a natural flowing of the condensation water.

Similarly, the body 7 as a whole could differ from the one shown in the figure, e.g. have the form of a parallelepipedon, and be provided with internal baffles to create a labyrinth pathway or have anyway a bigger development than the one defined by the simple overall dimensions of the body itself.

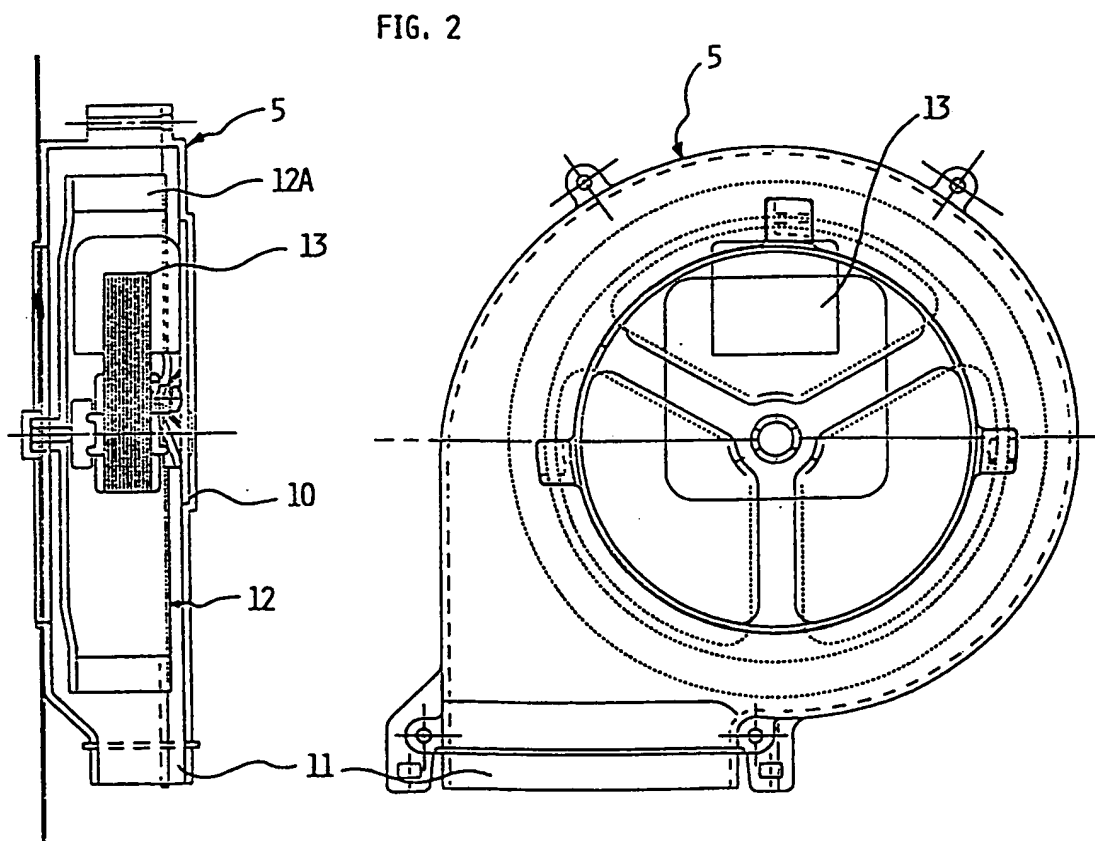
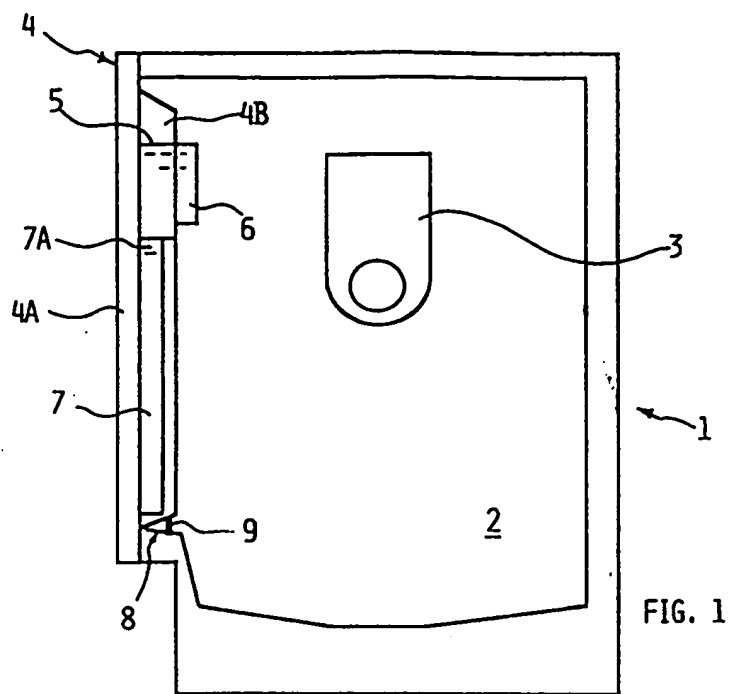
The condensation grids 15 could be in different numbers and positions from the ones shown in fig. 3 by way of example.

Finally, it is clear that the fan and the condensation body described above could also be housed in one of the washing chamber side walls, for instance near the vent device 3.

Claims

1. Dishwashing machine, comprising a fan (5,12,13) for inhaling from the washing-chamber of the machine the air full of steam created by the washing of the crockery, and a hollow body (7,7A) connected to said fan (5,12,13) and apt at favouring the condensation of the steam contained in said air, characterized in that means (7A) are provided to bring again in circulation at least some of the air that has already flown at least one time in said hollow body (7), so as to practically obtain a practically closed air circulation circuit.
2. Dishwashing machine, according to claim 1, characterized in that said body (7) is shaped for defining a tortuous pathway, whose development is bigger than that defined by the overall dimensions of the body itself (7), and that along said pathway one or more intermediate screens (15) are provided, for favouring the condensation of the steam contained in said air (15) forcibly flowing across them.
3. Dishwashing machine comprising a fan (5,12,13) for inhaling from the washing chamber (2) of the machine the air full of steam created by the washing of the crockery, and a hollow body (7,7A) connected to said fan (5,12,13) apt at favouring the condensation of the steam contained in said air, characterized in that said body (7) is shaped for defining a tortuous pathway having a bigger development than that defined the overall vertical and/or horizontal dimensions of the body itself (7) and in that along said pathway one or more intermediate screens (15) are provided, for favouring the condensation of the steam contained in said air (15) forcibly flowing across them.
4. Dishwashing machine, according to claim 3, characterized in that a conduit (7A) is provided, for a further connection between said fan (5,12,13) and said hollow body (7), in order to bring back in circulation the air already flown at least one time in said hollow body, said conduit (7A) allowing to obtain a practically closed air circulation circuit.
5. Dishwashing machine, according to claim 1, characterized in that said means comprise a conduit (7A) for a further connection between said fan (5,12,13) and said hollow body (7).
6. Dishwashing machine, according to at least one of the previous claims, characterized in that the air exiting said further conduit (7A) is mixed in the entry of said body (7), or of the scroll (5) of said fan, with the air full of steam inhaled by said fan (5,12,13) directly from the washing chamber (2) of the machine.
7. Dishwashing machine, according to claim 2, characterized in that said body (7) is provided with a series of curves defining said tortuous pathway, said curves being in particular in the horizontal direction, i.e. as an S, to favour the natural flow of the condensation water.
8. Dishwashing machine, according to at least one of the previous claims, characterized in that said condensation screens comprise grids (15), in a material being suitable to favour the condensation of the steam contained in the air inhaled from inside said chamber (2), such as a steel being austenitic and non-magnetic.
9. Dishwashing machine, according to at least one of the previous claims, characterized in that said body (7) has, in particular in its lower side, at least a drainage hole (16) for the condensation water, means (V) being in particular associated with said drainage aperture, for hindering a substantial emission of air in the environment outside the dishwasher.
10. Dishwashing machine, according to the at least one of the previous claims, characterized in that said fan (5,12,13) and said body (7) are both located in the door (4) between its external part (4A) and its inner shell (4B), i.e. the part of the door which faces the inside of the washing chamber (2).
11. Dishwashing machine, according to claims 9 and 10, characterized in that said drainage aperture (16) is realized so as that the dripping of the condensation water falls on a front lip (8) of the bottom of said chamber (2), said lip (8) protruding out of the chamber (2) in the area extending below said inner shell (4B).

12. Dishwashing machine, according to claim 1, characterized in that the impeller (12) of said fan (5,12,13) is concentric with respect to its motor (13), said motor (13) being in particular of the hygroscopically protected type. 5
13. Dishwashing machine, according to at least one of the previous claim, characterized in that means are provided to change the rotary speed of said fan (5,12,13), in particular with the purpose of allowing a controlled or partialized steam emission from said chamber (2). 10
14. Dishwashing machine, according to the previous claim, characterized in that air humidity sensing means are provided inside said chamber (2), the rotary motion of said fan (5,12,13) being controlled in particular through electronic control means, in function of the humidity or steam concentration inside said chamber (2) as detected by said sensing means. 15 20
15. Method for drying the crockery in a dishwashing machine, wherein a fan (5,12,13) is provided to inhale from the washing chamber (2) of the machine the air full of steam created by the washing of the crockery, said air being in particular recirculated in a substantially closed circuit, characterized by the following steps: 25 30
- during the initial drying step, the fan (5,12,13), which is in particular of the centrifugal type, is rotated to reach at least a first predetermined speed rate (1200 rpm), so that said first speed causes a slow steam outflow to avoid a strong ejection and also dilute the steam within the chamber with fresh air inhaled from the environment; 35
 - in a subsequent drying step, when most of the steam has been removed from the chamber and/or diluted inside it, the fan (5,12,13) rotates at a second speed rate (2400 rpm), substantially higher than said first speed rate. 40
16. Method for the drying of crockery, according to the previous claim, characterized in that the fan (5,12,13) is kept in operation as long as the air humidity detected through suitable sensing means does not go below a predetermined value. 45 50



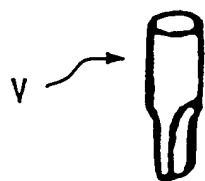
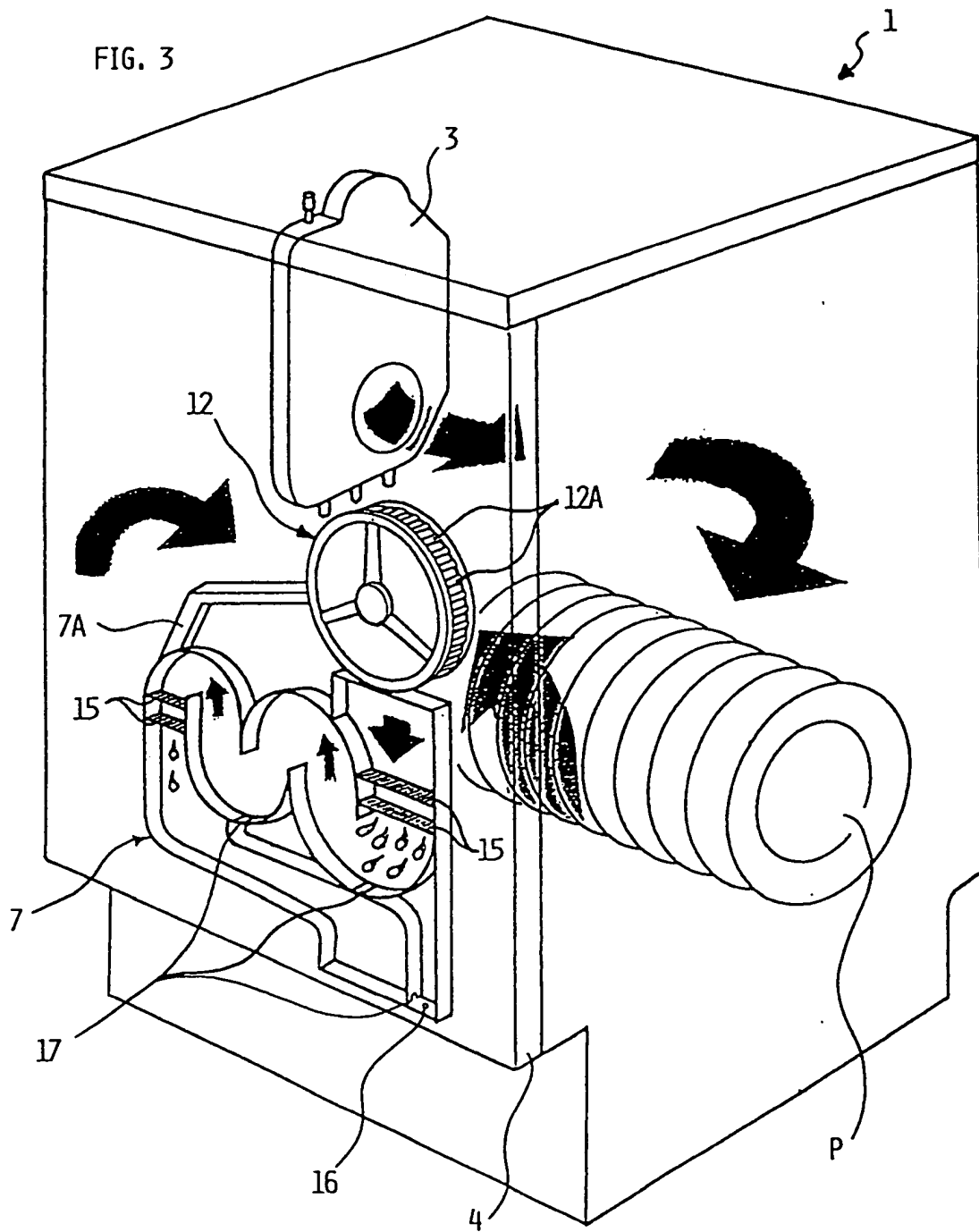


FIG. 4



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 0564

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR-A-2 491 322 (BOSCH-SIEMENS HAUSGERÄTE GMBH) * claims; figures *	1,9	A47L15/48
A	CH-A-683 819 (ELECTROLUX AG) * the whole document *	1-3,7, 9-16	
A	FR-A-2 173 824 (SOCIÉTÉ CHALECTRO COMPAGNIE DES MACHINES À LAVER LINCOLN) * the whole document *	1-3,7-11	
A	US-A-3 170 743 (GENERAL ELECTRIC COMPANY) * the whole document *	1-3,7-11	
A	US-A-3 908 681 (GENERAL ELECTRIC COMPANY) * the whole document *	1,3,9, 10,12,13	
A,D	EP-A-0 556 773 (MERLONI ELETTRODOMESTICI S.P.A.) * the whole document *	1,3,9, 10,12	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	FR-A-2 117 860 (MIELE & CIE GMBH) * page 2, line 27 - line 29; claims; figures *	1,10,12, 14	A47L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 6 May 1996	Examiner Courrier, G
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